

Technological Progress with Segmented Factor Markets and Welfare Implications for the Urban Poor

Sameen Zafar^{*}, Soumyatanu Mukherjee[¶]

[¶] CREDIT; Room B52, School of Economics, University Of Nottingham, University Park, Nottingham NG7 2RD; Email: Sameen.Zafar@nottingham.ac.uk;
Soumyatanu.Mukherjee@Nottingham.ac.uk.

(Preliminary draft, comments are welcome)

Abstract:

This paper models the urban informal sector for a typical developing economy with labour market distortion in the form of unionised urban sector labour market and segmentation between urban informal and formal credit markets using a four-sector static general equilibrium framework. It has been highlighted in the literature that the growth experience of South Asian countries such as India and Pakistan during the liberalised regimes has primarily been driven by the productivity take-off in the traded service sectors. The theoretical analysis in this paper offers another attempt to predict the implications of technological progress in the traded formal sectors on informal wage, taking into consideration that real wage is a reasonable benchmark to measure the well-being of the economically marginalised people living under informal arrangements. The key model propositions are further supported by a sensitivity analysis using plausible ranges of parameter values for India. We also conduct empirical analysis using data for twenty-seven Indian States (including one Union Territory) between 1989 and 2010. Our results illustrate that the growth in urban informal wage is significantly explained by the increase in the formal sector subcontracting activity which in turn is a result of productivity improvement in the formal sector. Finally we conclude the welfare implications for the urban poor, relating urban informal wage movements and likelihood of changes in urban poverty in recent years.

Keywords: Poverty; Technological Progress; Informal Wage; General Equilibrium.

JEL Classifications: E26; F11; F16; J46; I32; O17.

Acknowledgments:

We are grateful to Prof Oliver Morrissey, Prof Sugata Marjit, Dr Saibal Kar and Dr Markus Eberhardt for their valuable suggestions and comments.

1. Introduction:

It is well-known that in a developing economy the ‘informal sector’ hosts a substantial proportion of the workforce in unregistered activities, primarily characterised by the ease of entry and unregulated markets. As suggested by many authors (Agenor (1996), Schneider and Enste (2000) and the references therein) more than 70% of the workforce is engaged in the informal sector of a developing country (DC). In South Asian countries like India and Pakistan, a significant proportion (about 85% in non-agricultural activities of India for example) of the working population are engaged in the informal sector¹. In 1995, the informal sector accounted for almost 92.5 per cent of India's workforce (Subrahmanya and Jhabvala, 2000).

Here we define ‘informal’ sector as the unregulated sector where minimum wage laws are not maintained, pertaining to non-traded items in the economy, comprising of own-account enterprises as well as many subcontract firms producing various parts and semi-processed components for the parent formal sector firms. This definition allows us to focus on the economic conditions of the majority of the workforce in LDCs like India and Pakistan.

According to the International Labour Organisation (ILO) World Employment Report (ILO, 1998 p. 168), the informal sector is classified into three categories:

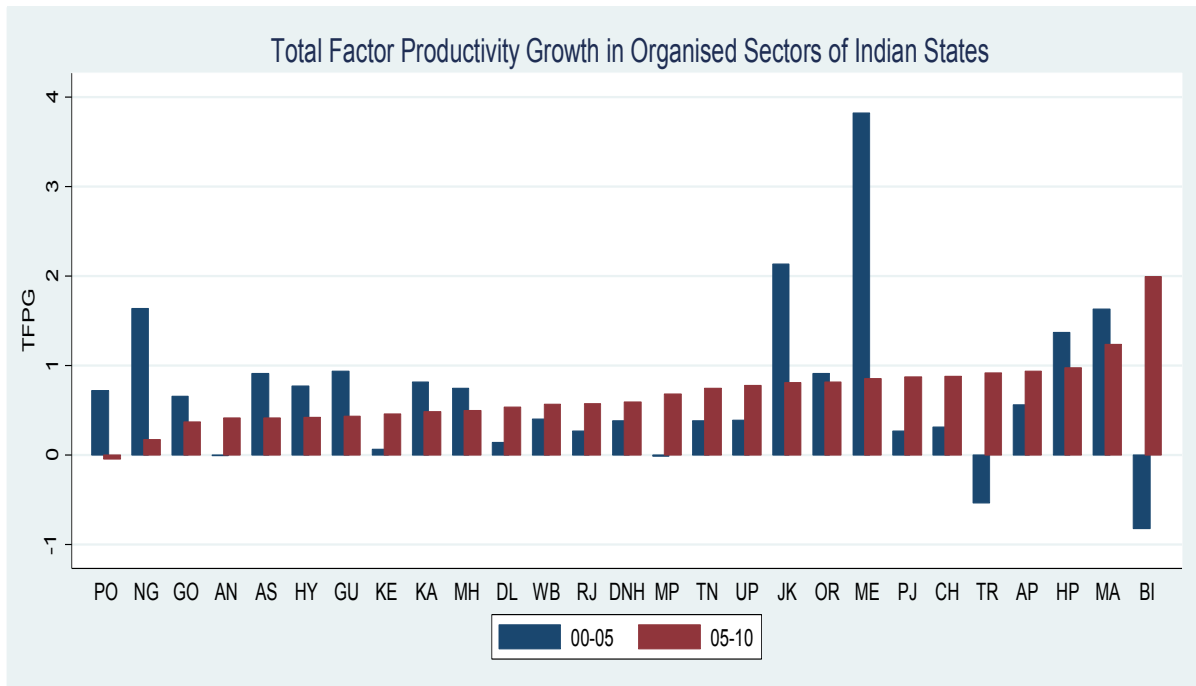
- a) The *micro-enterprise sub-sector* is the most important part, typically connected to the formal sector through various types of sub-contracting arrangements.
- b) The *household-based sub-sector*, where major activities are carried out by family members (mostly by unpaid female labour). Most households belong to the lower tail of the income-distribution and are unable to come out of the poverty-traps.
- c) The *independent service sector*, comprises of domestic helpers, street-vendors, cleaners, street-barbers etc., as well as those referred to as casual labour. The skills required for these occupations are of the most basic nature in the informal skill hierarchy.

As shown in different papers (Chaudhuri, 2001; Koizumi and Kopecky, 1977, 1980; Findlay, 1980) liberalising a developing economy may result in technological progress as a peer-effect (such as an inflow of foreign capital usually leads to transfer of technology from the foreign producers to the destination sector of the recipient country). Such productivity improvements can lead to a rise in per capita income of the host country (Chaudhuri, 2005; Mukherjee, in press). In fact, the most important determinant of the boom in Indian growth during the liberalised regime has primarily been the productivity improvement in the organised sectors. We use the survey data on the registered manufacturing industries across 27 major Indian states available from the Annual Survey of Industries (ASI) to compute total factor productivity growth (TFPG) using the growth accounting method² for the survey years 2000-01, 2005-06 and 2010-11. It is easily observable from Figure 1 that almost all the states have experienced productivity boom from 2000 – 2005 and from 2005 – 2010.

¹ For Pakistan, the microenterprise sectors are referred as the ‘informal sector’ (Berry, 1998).

² See Appendix III for details on the construction of TFPG.

Figure 1



NOTES: AN – Andaman & Nikoer; AP – Andhra Pradesh; AS – Assam; BI – Bihar; CH – Chandigarh; DL – Delhi; DNH – Dadra-Nagar-Haveli; GO – Goa; GU – Gujrat; HP – Himachal Pradesh; HY – Haryana; JK – Jammu & Kashmir; KA – Karnataka; KE – Kerala; MA – Manipur; ME – Meghalaya; MH – Maharashtra; MP – Madhya Pradesh; NG – Nagaland; OR – Orissa; PJ – Punjab; PO – Pondicherry; RJ – Rajasthan; TN – Tamil Nadu; TR – Tripura; UP – Uttar Pradesh; WB – West Bengal.

The organisation of production between the formal and informal segments would be affected following such a technological change. Consequently, there would be a significant impact on informal activities, wages and employment.

The informal sector mostly comprises of “wage hunters and gatherers” (Bremas 1994), usually but not always uneducated, with little or no chance of a living wage and no security. A large part of such employment opportunities is generated in the urban or semi-urban areas where majority of the workforce is economically marginalised. The social consequence of such overall rise in the growth rate must be reflected in the quality of life of the poor people. There has also been evidence (such as Sethuraman, 1997) suggesting that urban poverty tends to decline with economic growth in Asia and Africa. Kapsos and Bourmpoula (2013) have shown that the share of the extremely poor (less than \$US 1.25) has dropped from 43.3% in 1999 to 27% in 2011 whereas in Figure 1 we have shown that India has experienced a productivity boom in the traded service sectors over the ten-year period from 2000 to 2010 in almost all the states. Therefore, it can be stated that the benefits of productivity growth in the formal sectors must have percolated to the bottom of the income group working in the urban informal sectors. While it is difficult to assess such an impact at the micro level and in terms of various indicators of poverty and human development, the informal wage and employment can be considered to be the good indicators to link productivity improvement in the traded formal sectors and urban poverty, given that most of the urban workforce in a typical developing economy (such as India or Pakistan) is absorbed in this segment. These workers

look for what they can salvage on the margins of the industrial economy (this being literally the situation of the rag pickers and recyclers). These people mostly do not possess any assets. Only a small number of them find employment, that too temporarily at times, and the larger proportion of these workers have no choice but to “go out hunting and gathering a wage” (Bremner, 1996). They are not suffering from unemployment; but their problem is the abysmal wages offered to them which they often find insufficient to meet their minimum daily needs. Survival takes precedence over everything else (Pathy, 1993). Therefore, as argued in Kar and Marjit (2009), Marjit and Kar (2009) and by some other researchers, in the present context, informal wage can be considered as a reasonable benchmark to measure the living conditions of these poor people.

Therefore, the principal objective of this research is to examine whether and to what extent the productivity growth in the formal sectors will affect the informal sector wages and employment. In addition, we investigate how the informal sector wage will affect the incidence of urban poverty across various states of India.

Therefore, first, an extensive theoretical general equilibrium framework is adopted (keeping in mind the urban economy of a DC like India or Pakistan) to analyse the implications of uniform technological progress (owing to which all the factors of production become equally more productive in that particular sector experiencing technological progress) in the traded formal sectors on informal wage and employment, and to examine how far the consequences hinge on the nature of capital mobility between the formal and informal sectors of the urban economy. Thereafter, to complement the theoretical results, an empirical section is presented using survey data on informal and formal sectors of Indian states during the liberalised regime to gain an overall view on the wage movements in the urban informal sectors of Indian states and how that can be explained by capital accumulation in the informal sectors and the productivity improvement in the formal sectors, exploiting the vertical linkage between the formal and informal sectors. Finally, an explicit statement on the trend of urban poverty is offered, relating informal wage movements and the likelihood of urban poverty.

Section 2 provides a review of relevant literature and the major gap in existing research. Section 3 discusses the theoretical model and the results, while section 4 deals with the empirical analysis. Finally section 5 concludes.

2. The Existing Literature and Major Research Gap:

The key hypothesis we want to analyse is how informal wage is affected following a productivity take-off in the formal/organised sectors of the economy. Goldberg and Pavcnik (2003) and Marjit, Ghosh and Biswas (2006) have explored the asymmetric impact of reform policies on the size of the informal sector. However, DCs like India and Pakistan are also plagued by capital market segmentation among the organised formal and non-organised informal sectors. It has been shown theoretically (Marjit 2003; Marjit and Kar 2004; Marjit, Kar and Acharyya 2007; Marjit, Kar and Beladi 2007; Marjit and Kar 2008 a, b; Marjit Kar and Maity 2008) that informal wage can change depending on various degrees of capital

mobility between formal and informal sectors. These studies use simple general equilibrium structure to answer a critical question – how do exogenous policy changes in the formal sector affect the wage and employment conditions in the informal sector? Marjit and Kar (2009) assessed the implication of a tariff-cut in the organised formal sector on informal wages, explaining the notion of different degrees of capital mobility between informal and formal segments of the economy and how they affect the outcome on informal wage. However, while the paper by Marjit and Kar (2009) attempted to check trade policy induced relative price effects on real informal wage, this paper highlights the productivity issue explicitly.

It should be mentioned that Marjit and Kar (2008) explored the link between labour productivity growth and informal wage, emphasising the role of capital mobility between formal and informal segments of the economy. Moreover, it has been illustrated in different studies that informal sector firms are attached to the formal sector firms on a contractual basis. The formal sector firms are generally farming out a part or whole of their production to the informal sector firms to avoid different regulations and associated costs since the latter firms enjoy the advantage of cheaper labour supply. On the other hand, the informal firms are also dependent on formal firms for marketing their products and, in particular, for the supply of credit from the formal sector firms since the formal firms usually have an advantage over the informal firms in the credit market. Thus, it would be unrealistic to assume like Marjit and Kar (2008, 2009) that the informal sector produces internationally traded final good and capital is sector-specific and that the informal and formal credit markets are completely disintegrated even in the short-run. This is because the informal sector money-lender borrows capital from the formal credit market for re-lending. Hence a part of the formal credit enters the informal credit market. Therefore the ‘zero mobility’ case in Marjit and Kar (2008, 2009) paper is unlikely to happen in reality.

There has been a pertinent debate on the desirability of various types of technological progress among labour economists and trade-theorists (Jones 1996, 2003, 2006; Krugman 2000; Ethier 2005). Trade-theorists, emphasising the importance of relative factor intensities in different sectors (Jones 1965; Oladi and Beladi 2007 and Beladi et al. 2008) argue that a labour-augmenting type technological change in the labour-intensive sector will push the wages up. This result is in contradiction to the usual predictions of labour economists. Findlay and Jones (2000) argued that trade and labour theory outcomes will be merged for a major modification of production structure consequent upon such a technological progress. The most recent attempt has been made by Beladi et al. (2012) in terms of a simple two-sector general equilibrium model with segmented labour markets to show that technological progress leads to opposite wage movements independent of relative factor-intensity ranking between organised (formal) and non-organised (informal) labour sectors. But the simple two-sector set-up in Beladi et al. (2012) was not quite generic to portray the conditions of urban informal sector in a developing economy. It would be more realistic to classify the urban informal sector as comprising of an industrial segment that uses labour and capital to provide an intermediate input such as leather and rubber products, electrical equipment etc. to the formal sector firm, with the urban informal firm being tied to the formal firm by the system

of subcontracting. Another aspect of the informal service sector comprises producing non-traded services such as street-vendors with almost no use of capital. These possibilities have been considered in Kar and Marjit (2009) and this paper has adopted the same set-up since we believe their production-structure is quite generic and plausible to map the urban informal sector for a poor developing economy. However, Kar and Marjit (2009) did not consider any dualism in domestic capital market. The dominant feature of dualism in the capital market is the fragmented interest rate structure, featuring lower allocation of loanable capital to the informal sector at a higher relative rental rate. The informal producers do not have access to credit from formal institutions and, therefore, have to depend on the informal credit market, where rental cost of capital is exorbitantly high. We are going to incorporate this issue in our model and hence this will become our point of departure from Kar and Marjit (2009).

3. The Theoretical Model:

Consider a static general equilibrium model for a small, open developing economy with four sectors: two urban formal sectors and two urban informal sectors. Among the two informal sectors, one is an informal service sector (sector 1) providing non-traded services by the unskilled (surplus) labour of the economy. Another sector (sector 2) is within the industrial set-up, producing a non-traded intermediate input using unskilled labour and capital for the formal export sector. Within the formal segment, the export sector (sector 3) uses skilled labour³, capital and the intermediate input in the production process. Skilled wages are fixed at a higher level by prior negotiations with labour unions. We do not explicitly model wage-fixation given the focus of our paper and we will treat skilled wages as institutionally given⁴. Sector 4 is the tariff-protected import-competing sector of the economy using skilled-labour and capital in its production process. Countries such as India and Pakistan export primary agricultural products and also products requiring high level of skills such as computer software (particularly India); while they are the net importers of relatively more capital-intensive but less skill-intensive manufacturing products. Therefore, we assume that sector 4 is the most capital-intensive sector in the economy. In the Heckscher-Ohlin-Subsystem (HOSS) formed by the two formal sectors, sector 4 is relatively capital-intensive compared to sector 3 in physical and value terms. Production functions follow constant returns to scale (CRS) technology.

The following notation is used:

W = competitive informal wage rate for unskilled labour (\bar{L});

³ Here by ‘skilled’ we do not mean only human capital. In fact, the labourers in the formal sectors are distinguished from the informal sector workers in terms of productivity. So by ‘skilled labour’ we mean the combination of wage-earners, managers, supervisors and clerical job-performers in the organised sector. And by ‘skilled wage’ we mean total wages and salaries paid to them, which includes the payments to the managers and supervisors.

⁴ For a similar treatment of unionised wage in the organised sector one can see Chaudhuri (2005), Mukherjee (2012, 2014). Chaudhuri (2003) has provided an explanation about how the unionised wages are determined through the collective bargaining process.

W_S^* = Institutionally given skilled wage rate in formal segment of the economy;

R = rate of interest in the informal credit market;

r = rate of interest in the formal credit market;

a_{ji} = amount of the j^{th} factor used to produce 1 unit of the i^{th} good ($j = L, S, K; i = 1, 2, 3, 4$);

a_{23} = per-unit requirement of the non-traded intermediate input in the export sector;

\bar{K} = total stock of capital in the economy;

\bar{S} = stock of skilled labour in the economy;

K_1 = available capital in informal sector;

P_i = domestic prices of non-traded goods ($i = 1, 2$);

P_i^* = internationally given prices of traded goods ($i = 3, 4$);

t = ad-valorem rate of tariff imposed on good 4.

θ_{ji} = cost-share of factor j in the production of good i ;

λ_{ji} = share of sector i in the total employment of factor j ;

Λ = proportional change.

Price-unit cost equality in competitive product markets entail:

$$W a_{L1} = P_1 \quad (1)$$

$$W a_{L2} + R a_{K2} = P_2 \quad (2)$$

$$W_S^* a_{S3} + r a_{K3} + P_2 a_{23} = P_3^* \quad (3)$$

$$W_S^* a_{S4} + r a_{K4} = P_4^* (1 + t) \quad (4)$$

We assume the following functional relationship between R and r :

$$R = \rho r; \rho > 1 \quad (5)$$

Here ρ denotes the degree of imperfection of the informal credit market; $\rho > 1$ implies that $R > r$. This is because the informal moneylenders generally borrow funds from the formal sector at the market rate of return r , re-lend it to the informal borrowers and by this way maximises net interest income⁵. Therefore, it is realistic to assume that informal interest rate is positively related to and steeply higher than the formal interest rate. The lower the number of alternative sources of credit to the borrowers in the informal sector, the higher is the

⁵ So r could also be interpreted as the opportunity cost of lending credit to the moneylender.

degree of imperfection in the informal credit market and thereby the higher the power of the informal sector lenders to mark up interest rate in the informal credit market over the one in formal capital market (i.e. the greater the value of ρ).

Using (5), Equation (2) can be written as

$$Wa_{L2} + \rho ra_{K2} = P_2 \quad (2.1)$$

Equations (1), (2.1), (3), (4) are the price-unit cost equality conditions for the informal service sector, intermediate input producing sector, the export (formal) sector and the import-competing manufacturing sector, which is relatively capital intensive compared to the vertically integrated export sector.

We also assume that the amount of credit allocated to the informal sector is a positive function of the return differential between the two capital markets. Therefore as long as $\rho > 1$, informal capital market exists and thus the dichotomy between the two credit markets exists.

$$K_1 = K_1(R - r) = K_1\{r(\rho - 1)\}. \text{ So when } (R - r) \geq 0, K_1'(\cdot) \geq 0. \quad (6)$$

Thus, full utilisation of informal credit implies:

$$a_{K2}X_2 = K_1\{r(\rho - 1)\} \quad (7)$$

Note that *Equation (7) is not an independent equation since it only states that part of the available credit is allocated to the informal credit market*⁶.

The two urban formal sectors use the formal credit. The equilibrium in the formal credit market ensures that⁷

$$a_{K3}X_3 + a_{K4}X_4 = \bar{K} - K_1\{r(\rho - 1)\} \quad (8)$$

The full employment of unskilled labour implies:

$$a_{L1}X_1 + a_{L2}X_2 = \bar{L} \quad (9)$$

The full employment condition for skilled labour implies

$$a_{S3}X_3 + a_{S4}X_4 = \bar{S} \quad (10)$$

The demand-supply equality condition for the non-traded input gives:

$$a_{23}X_3 = X_2 \quad (11)$$

Also we assume that per-unit requirement of the intermediate input in sector 3 is constant. It rules out the possibility of substitution between the non-traded intermediary and other factors of production in sector 3. This is not an unrealistic assumption. For example, consider an

⁶ For similar treatment see Chaudhuri (2003).

⁷ Here the presence of foreign capital in the economy's capital endowment is assumed away.

automobile industry where the various parts (such as tyres) and semi-processed components are produced by the informal subcontracting firms. The automobile maker always uses four tyres produced by the informal firms for building and marketing a car. Hence, there remains a fixed proportion between the use of the intermediate input and the quantity of the final commodity produced and marketed by the formal sector. Gupta (1994), Chaudhuri (2005) and Chaudhuri et al. (2006) have used this assumption.

We have nine independent equations, namely Equations (1), (2.1), (3), (4), (6), (8)–(11) to solve for nine endogenous variables: $W, r, P_1, P_2, K_1, X_1, X_2, X_3$ and X_4 ; given the parameters: namely the world prices of commodities 3 and 4, W_S^* , t , ρ , \bar{K}, \bar{L} and \bar{S} . The four price variables can be solved in the following way: r is determined from Equation (4) given the unionised skilled wage and exogenous price of the importable. Given r , one can determine P_2 from Equation (3) and given the policy-parameter ρ , substituting r and P_2 in Equation (2.1) one can obtain W . Finally from Equation (1) P_1 is found substituting W . Once factor prices are known, factor-coefficients a_{ji} s are also known. Now using the value of r and given ρ , we can find $K_1(\cdot)$ from Equation (6). Then simultaneously solving Equations (8) and (10) we get X_3 and X_4 . Then X_2 is solved from Equation (11). Substituting X_2 in Equation (9), X_1 will be solved.

3.1. Comparative Static Exercises⁸

First let us assume the productivity parameters are such that only sector 4 (the import-competing and relatively capital-intensive segment of the formal zone) experiences ‘uniform technological progress’ by $\alpha > 0$. This essentially means the same percentage reduction (i.e. by $\alpha\%$) in skilled-labour and capital coefficients in sector 4. Then the implication on informal workers can be summarised in the following proposition.

Proposition 1:

In the absence of any reform in the informal credit market, a productivity take-off in the relatively capital-intensive import-competing formal segment unambiguously reduces commodity prices and wages in both informal sectors. The informal sector producing intermediate input for the export sector is more likely to contract in terms of both output and employment; whereas the non-traded service sector is more likely to expand. However, if the government would intervene to undertake a reform policy which would reduce the mark-up power of the informal money-lenders, that could help the workers in intermediate input producing sector.

Intuitive Explanation: If the relatively capital-intensive import-competing formal segment (sector 4) undergoes technological progress (uniform or factor-specific) by $\alpha > 0$, it will

⁸ The detailed algebraic results are provided in the appendix.

raise only the rental to capital (given the fixed skilled wage); given that the production functions in these two sectors are of variable-coefficient type, this will encourage a Rybczynski-type effect in the Heckscher-Ohlin Subsystem (HOSS) formed by sector 3 and sector 4 following which the relatively capital-intensive sector 4 expands but the export sector (sector 3) contracts. Therefore, the demand for non-traded intermediate input falls given supply. This will reduce the price of the intermediate input (P_2); whereas rental costs paid by the informal producers rise. As a result, from the zero-profit condition of sector 2 (the intermediate input producing sector), it is clear that competitive unskilled wage rate should fall. At the same time, since intermediate input is used in a fixed proportion in the export sector production, which cannot be supplemented by other factors of production in sector 3, this implies that sector 2 must shrink as well (complementary relationship between these two sectors). Hence sector 2 will release unskilled labour which will be absorbed in sector 1, but at a lower competitive wage than before. We call it the ‘first round’ effect.

However as r rises, $(R - r) = r(\rho - 1)$ goes up as well. This will lower the supply of capital to the formal capital market. This will induce a Rybczynski effect in the HOSS which would tend to expand sector 3 and sector 2 (by the complementarity assumption explained above) and we term it as the ‘second round’ effect. But this ‘second round’ effect is entirely the by-product of the ‘first round’ effect. Therefore the ‘first round’ effect is likely to dominate and both sector 3 and sector 2 are likely to contract as a consequence.

In fact, it can readily be seen from our framework that if government would intervene aiming to reduce the degree of imperfection in informal credit market and hence the informal rental return (by reducing ρ) in this scenario⁹, that would tend to reduce the capital-cost of intermediate input producers and thus would help the workers in sector 2. But in the absence of any such reform, rental cost of intermediate input producers would always rise unambiguously following technological improvement in sector 4. As a result, some of the industries in sector 2 would shut down and the rest will try to survive using less capital-labour ratios in per-unit of production. This implies that only those unskilled workers who are relatively more productive will remain in sector 2 and the rest will join sector 1. This is welfare reducing from various points:

- a) The downward pressure on wages of informal workers has a clear impact on aggravating poverty in the urban areas. This is because a large share (above 78%) of

⁹ Government intervention aiming to integrate the formal and informal credit institutions through appropriate linkages is the most feasible way to achieve this. Since credit is not directly accessible from formal sources, the focus should be on provision of microfinance and related services to informal sector enterprises, strengthening of the institutional framework in this area, creation of alternative sources of credit, and developing alternative delivery mechanisms. Most of these interventions in different countries have focused on alleviating credit constraints for the rural poor, but some have also targeted the urban poor. Among these, the following are widely known: Grameen Bank in Bangladesh; Bank Rakyat Indonesia (BRI); and Prodem (the Fundaci' on para la Promoci' on y Desarrollo de la Microempresa) in Bolivia. (See Jackelen, H.R. and Rhyne, E. (1991) for details). Apart from governmental initiatives, self-help groups can also have a considerable role in alleviating the problem of obtaining credit. A self-employed women's association (SEWA) in Ahmedabad and the Working Women's Forum (WWF) in Madras, both in India, have created their own banks along the lines of cooperatives to cater to the credit needs of poor women; they follow mechanisms similar to those described above and reach well over half a million.

the urban poor in India and Pakistan work in the informal sector and any reduction in the wages of the informal workers may significantly increase the incidence of poverty.

- b) Sector 2 contracts in terms of both output and employment; so workers are forced to leave the unregulated manufacturing firms and take up insecure non-traded service sector jobs with lower earnings and hence greater likelihood of poverty.

When only the export sector undergoes technological progress by $\alpha > 0$, following proposition is imminent from our model.

Proposition 2:

If only the export sector would undergo productivity improvement by $\alpha > 0$, ceteris paribus, product prices and competitive real wages of the informal workers will go up in both informal sectors. Also the intermediate input producing sector would expand in terms of both output and employment. A government policy of capital-market reform in the informal sector would encourage this wage-improvement even more in this scenario.

Intuitive Argument: Since the return to capital in the formal sector, r , is already determined from the zero-profit condition for sector 4; the technological progress in sector 3 would lead to an increase in price of the intermediate input. So from the zero-profit condition of sector 2 it is imminent that the real informal wage would increase. The producers in the intermediate input producing sector will substitute capital for the costlier labour in the production. Given the endowment of capital in the economy, this will create relative shortage in capital-availability and therefore a subsequent Rybczynski effect in the HOSS. Under our reasonable assumption that sector 4 is relatively more capital-intensive than sector 3 in physical and value terms, sector 4 will contract while sector 3 will expand and given the complementary relationship between sector 3 and sector 2, sector 2 will expand as well. As a result, unskilled labourers will move from sector 1 to sector 2 and sector 2 will expand both in terms of output and employment.

Now if the government would undertake a policy to reform the informal credit market in this set-up, this would reduce R by reducing ρ . From the zero-profit condition for the intermediate input producing sector, it is clear that it will make the informal wage increase even more pronounced.

3.1.1. Uniform Technological Progress by $\alpha > 0$ in All Traded Sectors and Informal Wage Response – A Sensitivity Analysis for India.

We examine here the implication of a uniform technological progress shown by $\alpha > 0$ in both export and import-competing formal sectors on the informal wage (not taking into account any government policy of credit market reform in the informal sector). So each of the two formal sectors undergo uniform technological improvement by α . We will show this by using a sensitivity analysis for India. Totally differentiating Equations (1), (2.1), (3) and (4);

applying envelope conditions and using Cramer's rule, allowing for both sectors 3 and 4 to undergo productivity take-offs by $\alpha > 0$, the key equation of change will become:

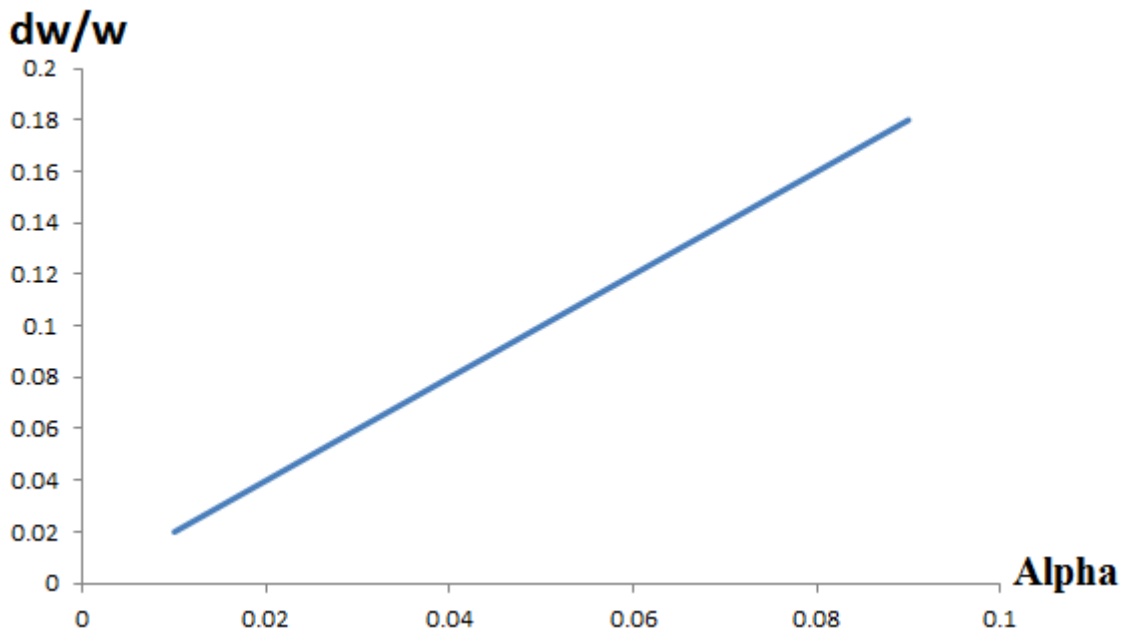
$$\widehat{W} = \frac{\alpha}{\theta_{23}\theta_{L2}} \left\{ 1 - \frac{(\theta_{K3} + \theta_{K2}\theta_{23})}{\theta_{K4}} \right\} = (\alpha/\theta_{23}\theta_{L2}) \{ (\theta_{K4} - \widetilde{\theta}_{K3})/\theta_{K4} \} = (\alpha/\theta_{23}\theta_{L2}) (|\theta|/\theta_{K4}) \quad (12)$$

Where $\widetilde{\theta}_{K3} = \theta_{K3} + \theta_{23}\theta_{K2}$ represents the share of capital costs in sector 3 for both its direct and indirect use of capital. $|\theta| = \theta_{K4} - \widetilde{\theta}_{K3} = (\theta_{K4}\theta_{S3} - \widetilde{\theta}_{K3}\theta_{S4}) > 0$ if the vertically integrated sector 3 is relatively less capital-intensive than sector 4 in value-terms.

We use Equation (12) to quantify the relationship between productivity change in the formal sectors and changes in informal wage. We assign the following parameter values for the initial equilibrium according to the assumptions in the model in a close approximation to the actual data for India¹⁰.

$$\theta_{K2} = 0.3; \theta_{K3} = 0.4; \theta_{23} = 0.1 \text{ (fixed); } \theta_{K4} = 0.5.$$

Figure 2: Relationship between Growth in Informal Wage and Uniform Productivity Improvement in Formal Sectors (α)



Note that the relationship between technological progress in the formal sectors and change in informal wage is positive. Thus, given the parameter values we have adopted for initial equilibrium, when the formal sector of the economy (i.e., both sectors 3 and 4 in our model) undergoes technological improvement by 5% or 8%, the model predicts that informal wage would increase by about 10% and 16% respectively.

This is because in our model when both formal sectors experience uniform technological progress by $\alpha > 0$, the relatively capital-intensive sector 4 would demand more capital to

¹⁰ See Appendix II for the details of the sources and different ranges of parameter values.

expand which would push up the return to capital in both informal and formal sectors. This would lead to the ‘first round effect’ mentioned before. At the same time the relatively capital un-intensive sector 3 is also experiencing technological progress and it would try to expand by saving on capital cost and demanding more of the non-traded intermediary from sector 2. If the vertically integrated sector 3 is relatively less capital-intensive vis-à-vis sector 4 in value-sense (i.e., $|\theta| > 0$), then only sector 3 expands and therefore sector 2 will also expand. This will encourage sector 2 producers to hire more workers and consequently informal wage will increase. This positive impact on informal wage depends crucially on how much sector 3 has been able to save on its capital costs of production (i.e. the sign of $|\theta|$). As we will show in our numerical analysis in Table 1, a small decrease in capital cost share in sector 3 would increase the growth in informal wage.

In this scenario when capital accumulation in the informal sectors rise, lower capital availability in the formal sectors will further help the export sector to expand (‘second-round effect’ as mentioned earlier). Sector 2, would only expand by substituting labour for capital, which would increase the demand for informal workers in sector 2 and the informal wage.

Therefore, capital mobility between the formal and informal sectors should also be crucial for the upsurge in informal wage in response to uniform technological progress in all the traded formal sectors of the economy. This fact is supported further in the empirical analysis.

We use the following table to verify Equation (12) in response to changes in the parameters (except the cost share of intermediate input in the export sector, θ_{23} , which is held fixed). We adopt $\alpha = 0.08$ in case of India (Kathuria et al. 2013). As expected, if the cost share of capital in the export sector goes down by just 7.5% from the initial equilibrium value, the informal wage rises by 23% whereas in initial equilibrium, the increase in informal wage was about 16%. If cost share of capital in sector 4 goes up by 10%, then the subsequent Rybczynski-type effect in the HOSS will benefit the informal workers in terms of wages and employment.

Table 1: Effect of $\alpha = 0.08$ under Parametric Assumptions

<i>Simulation Rounds</i>	$\theta_{K2} = 1 - \theta_{L2}$	θ_{K3}	θ_{K4}	$\theta_{23}(\text{fixed})$	\widehat{W}
<i>Sim1 (Initial Equilibrium)</i>	0.3	0.4	0.5	0.1	0.16
<i>Sim 2</i>	0.3	0.37 (↓)	0.5	0.1	0.23 (↑)
<i>Sim 3</i>	0.3	0.4	0.55 (↑)	0.1	0.25 (↑)

4. Empirical Evidence for India:

Empirical evidence on the relationship between trade and informal wage is dependent on country-specific characteristics. There is some evidence from India such as in Kar et al. (2003) that trade liberalisation increases informal wage through capital reallocation from formal to informal sectors. In this section, some evidence is provided from the liberalisation experience in India. For informal sectors there exist surveys conducted by 'National Sample Survey Organisation' (NSSO) of the Government of India. In particular, given our concerns in this paper, we have used data from various rounds of this survey on average yearly wage and fixed assets formation in Non-Directory Manufacturing Establishments (NDMEs) in the urban sector, because of their strong interlinkages with urban formal sectors for 1989-90, 1994-95, 2000-01, 2005-06 and 2010-11 across twenty-six Indian States and one union territory (Chandigarh). For the formal sector, we have taken data on registered manufacturing sector net value added and net capital accumulation on these years for these twenty-seven cross-sectional units from Annual Survey of Industries (ASI), Government of India. The informal sector real wages have been constructed by deflating the nominal wages using 2001-02 Consumer Price Index (CPI). And the informal real fixed assets (proxy for capital accumulation in the informal sector) have been formed by deflating the nominal figures using 2001-02 Wholesale Price Indices (WPI) for Machinery and Machine Products.

Next we provide a broad measure of input purchases by the formal sectors from local informal firms. This variable captures the notion of vertical production linkage between urban formal and informal sectors or the formal sector subcontracting activity owing to which formal/registered firms farm out their production to the vertically integrated informal firms. We term this variable as 'linkage', which is the sum of:

- (a) Value of products sold by the registered factories in the same condition as purchased from the other local firms; and
- (b) Cost of contract and commission work done by others on materials supplied by the factory.
- (c) Total delivered value of all other materials (other than fuel), which have not been produced by the registered factories.

The first two items together constitute a measure of subcontracting. Ramaswami (1999) measured subcontracting intensity in formal sectors in a similar fashion. He used the ratio of the value of goods sold in the same condition as purchased to value added as a measure, but that excludes other forms of subcontracting recorded as contract work performed on materials supplied.

We have constructed this 'linkage' variable (Link) as 'total inputs' minus 'fuel consumed' in the ASI survey data. Subsequently, this variable was deflated using 2001-02 WPI for Manufactured products.

All the price indices (CPI, WPI for Manufactured products and WPI for Machinery and Machine products) were available at the national level, thus price differences between states were adjusted using the ratio of state to national GDP deflator.

During the liberalised regime, although more labour and capital have been reallocated to the urban informal sectors, we observe a positive trend in informal wage growth across the states and the union territory (U.T.) of India in the post-reform period, as observed in Figure A3.1 of Appendix III. At the same time, urban formal sector also experienced higher productivity growth as mentioned in the introduction section. In fact, Figure A3.2 in Appendix III shows labour productivity has also increased fairly across the states and the U.T. of India in this period. The general equilibrium analysis in the earlier section reveals that such growth in the formal sector can lead to growth in the urban informal wage and employment through the vertical linkage between the formal and informal production activities.

Our central purpose in this empirical section is to complement the theoretical results utilising this vertical production linkage. Here we intend to show that productivity improvement in the formal sector will encourage the formal producers to demand more intermediate inputs and services provided by the urban informal sector. Due to this, informal sector producers will be encouraged to hire more workers which will increase the informal wage.

Figures A3.5 and A3.6 display the causal relationship between labour productivity and the intermediate input usage by the formal sector for the years 1994 and 2010 respectively. This causal relation is shown by producing a linear fit with 95% confidence interval for the twenty-six Indian states and one U.T.¹¹ As we have seen, the relationship is fairly positive. Thereby, we can conclude that increase in labour productivity in the urban formal sector leads to an increase in intermediate input usage by the formal producers. In Appendix 3, Figure A3.3 illustrates that the growth rate of the subcontracting activity has been fairly positive across the majority of the states during the liberalised regime. Therefore, we utilise this information and try to explain the extent to which the increase in demand for the intermediate inputs and services by the formal producers would affect the urban informal wage. In Appendix 3, Figure A3.4 shows high rate of growth of informal fixed assets in almost all the states. Thus, we also attempt to illustrate how an increase in the capital stock (measured by the increase in real fixed assets formation in the NDMEs) would contribute to the growth in the informal wage.

Therefore, for the purpose of our analysis, we will estimate the following equation:

$$w_{it} = \alpha_0 + \beta_1(Link)_{it} + \beta_2(FA)_{it} + u_i + e_{it} \quad (13)$$

Where w is the real urban informal wage, α_0 is constant, FA is the real fixed assets formation in the urban NDMEs, u_i is the permanent effect associated with individual units and captures unobserved time-invariant individual heterogeneity that effects informal wage. Each i

¹¹ For the sake of brevity we are only presenting two years' graphs although the remaining years also exhibit the same pattern.

denotes one Indian state (U.T.) and t denotes year. The error term is $e_{it} \sim N(0, \sigma_e^2)$; whereas u_i can be either fixed parameters or $u_i \sim N(0, \sigma_u^2)$. If there are no individual effects, that is $\sigma_u^2 = 0$ or $u_i = 0$ for all i , in which case Ordinary Least Squares (OLS) will be most appropriate (efficient). But if there are individual effects and these are not correlated with the regressors, then random effects estimator will be most appropriate. However when there are individual effects and they are correlated with the regressors, the fixed effects estimator is the only appropriate method (Cameron and Trivedi, 2010).

The Breusch and Pagan Lagrangian Multiplier test for Random Effects is applied to decide between the adoption of the Pooled OLS versus the Random Effects model. The p-value obtained from this test is 0.120 so that the test goes in favour of the Pooled OLS model as we accept the null hypothesis of no Random Effects. However, in this paper, both the Random Effects and Fixed Effects results are also presented in Appendix III (Table A3.2) for the purpose of comparison as it can be argued that p-value is marginally different from the 10 percent significance level. We also test whether the Random Effects or the Fixed effects model is more appropriate by using the Hausman test. The null hypothesis of the Hausman test is that individual effects are not correlated with the regressors (Cameron and Trivedi, 2010). A p-value of 0.325 is obtained, hence we cannot reject the null hypothesis and the test goes in favour of the random effects model. Since the Pooled OLS model has already emerged as the preferred over the Random Effects model, we draw our conclusions on the basis of the pooled model.

From the Pooled OLS model (shown in Table A3.2 in Appendix III) it is evident that both the real FA and the 'linkage' variable (which captures formal sector subcontracting as mentioned earlier) are highly significant and positive. Thus, both of the variables lead to an increase in real informal wage, *ceteris paribus*¹².

However, we are aware of the data limitations which restricts our sample to a smaller number of observations. With access to more comprehensive state-industry level data for the informal sector, this analysis can be further enhanced in future research. Also, further insights can be gained by using cross-country panel data for both informal and formal sectors (in context of South Asia), once such data become accessible.

Finally, this paper has also attempted to incorporate the association between the urban informal wage and urban poverty at the state level by calculating the poverty head count ratios in the urban areas for the years 2004-05 and 2011-12. As demonstrated in Appendix III, Figure A3.7, the head count ratio has fallen across all the states except Nagaland. The increase in the urban informal wage between 2005 and 2010 (as shown in Appendix 3, Figure A3.1) in these Indian states can plausibly be one significant reason for the decrease in urban

¹² The instrumental variable (IV) approach was also adopted because the linkage variable was expected to be endogenous in our model. Therefore, the linkage variable was instrumented using the formal value added (FVA) as FVA is expected to be uncorrelated with the informal wage. When the Hausman test was performed between OLS and IV, the test went in favour of OLS.

poverty headcount ratio, given the fact that the majority of the urban poor in India are engaged in the non-agricultural urban informal sector¹³.

3. Concluding Remarks:

Recent growth in the Indian economy is fuelled primarily by an upsurge in productivity in the traded sectors which has been quite substantial over the recent years. Given that informal activities comprise the majority of the urban workforce, which is economically marginalized, we investigate how technological progress in the traded sectors of the economy would affect the informal wage with segmentation in factor markets.

In our simple general equilibrium model, in the traded formal sectors wages are pegged at a higher level than the competitive wages by prior negotiations with labour unions; while dualism in the capital market is characterised by the fragmented interest rate structure, featuring lower allocation of loanable capital to the informal sector at a higher relative rental rate.

We have provided a sensitivity analysis of our model using plausible ranges of parameter values for India and also provided empirical evidence from Indian data for twenty-seven States (including one U.T.) over 1989-2010. Our sensitivity analysis supports the fact that a uniform productivity take-off by equal percentage in all the traded formal/organised sectors could potentially help the informal workers if the vertically integrated export sector could save more on their capital cost of production. In other words, less capital will be allocated in the formal sectors of the economy vis-à-vis the informal sectors.

In our empirical section, we have shown that productivity growth in the formal sector has led to an increase in the subcontracting activity and input purchases by the formal firms, which has encouraged the informal workers to produce more of the intermediate inputs and to demand more hired workers. This has contributed to the recent upsurge in urban informal wage. Furthermore, our empirical analysis supports our theoretical prediction that greater capital accumulation in the urban informal sector of Indian states has corroborated this upswing in the urban informal wage.

The calculated poverty head count ratios demonstrate that the incidence of urban poverty has declined for nearly all the states from 2004-05 to 2011-12, while urban informal wage has also increased for these states over 2005-2010. Therefore we have addressed the crucial policy-question, that is, whether and under what economic conditions the benefits of productivity improvement in the traded sectors would trickle down to the marginalised workforce in the urban areas working in so-called 'informal sectors' through the impact on their real wages and employment conditions.

¹³ We are, also in a way to construct an FGT (Foster-Greer-Thorbecke) index for these two years on state-wise basis to get a more comprehensive picture on the incidence of urban poverty during this period.

References:

1. Agenor, P.R. (1996), 'The Labor Market and Economic Adjustment', *IMF Staff Papers* 32, pp. 261 – 335.
2. Beladi, Hamid, Chaudhuri, Sarbajit and Yabuuchi, Shigemi (2008), 'Can International Factor Mobility Reduce Wage Inequality in a Dual Economy?' *Review of International Economics* 16, pp. 893 – 903.
3. Beladi, Hamid, Vina, Lynda De la and Marjit, Sugata (2012), 'Technological Progress with Segmented Labor Markets', *Review of Development Economics* 16(1), pp. 148 – 152.
4. Berry, Albert (1998), 'The Potential Role of the SME Sector in Pakistan in a World of Increasing International Trade', *Pakistan Development Review* 37(4), pp. 37:4, 25–49.
5. Breman, Jan (1994), *Wage Hunters and Gatherers*, (Collection of essays, including articles). Oxford University Press: New Delhi.
6. Breman, Jan (1996), *Footloose Labour*, Cambridge University Press, Cambridge.
7. Cameron, A.C. and Trivedi, P.K. (2010), *Microeconometrics Using Stata*, Stata Press, Texas, USA.
8. Chaudhuri, S. (2003), 'How and how far to liberalize a developing economy with informal sector and factor market distortions', *J. Int. Trade & Economic Development* 12(4), pp. 403-428.
9. Chaudhuri, S. (2005), 'Labour Market Distortion, Technology Transfer and Gainful Effects of Foreign Capital', *The Manchester School* 73(2), pp. 214–227.
10. Chaudhuri, S., Yabbuchi, S. and Mukhopadhyay, U. (2006), 'Inflow of Foreign Capital and Trade Liberalization in a Model with an Informal Sector and Urban Unemployment', *Pacific Economic Review* 11(1), pp. 87–103.
11. Ethier, Wilfred J. (2005), 'Globalization, globalisation: Trade, technology, and wages', *International Review of Economics & Finance* 14(3), pp. 237–258.
12. Findlay, R. (1978), 'Relative Backwardness, Direct Foreign Investment and the Transfer of Technology: a Simple Dynamic Model', *Quarterly Journal of Economics* 92, pp. 1–16.
13. Findlay, Ronald and Jones, Ronald W. (2000), 'Factor Bias and Technical Progress', *Economics Letters* 68, pp. 303 – 308.
14. Goldberg, P and N Pavcnik (2003): 'The Response of the Informal Sector to Trade Liberalisation', *Journal of Development Economics* 72(2), pp. 463–496.
15. Guha-Khasnobis, B. and Faisal Bari (2003), 'Sources of Growth in South Asian Countries' in Isher Judge Ahluwalia and John Williamson (Eds.), *The South Asian Experience with Growth*, Oxford University Press.
16. Gupta, M. R. (1994), 'Duty-Free Zone, Unemployment and Welfare: a Note', *Journal of Economics* 59, pp. 217–236.
17. ILO (1998), *World Employment Report*. International Labour Office, Geneva.
18. Jackelen, H.R. and Rhyne, E. (1991), 'Towards a More Market-oriented Approach to Credit and Savings for the Poor' *Small Enterprise Development* 2(4), December.

19. Jones, Ronald W. (1965), 'The Structure of Simple General Equilibrium Models', *Journal of Political Economy* 73, pp. 551 – 572.
20. Jones, Ronald W. (1971), 'A Three-factor Model in Theory, Trade and History', in Bhagwati, J., et al. (eds.), *Trade, Balance of Payments and Growth*, North-Holland, Amsterdam.
21. Jones, Ronald W. (1996), 'International Trade, Real Wages and Technical Progress: The Specific-factors Model', *International Review of Economics and Finance* 5, pp. 113 – 124.
22. Jones, Ronald W. (2003), 'Joint Outputs and Real Wage Rates', *International Review of Economics and Finance* 12, pp. 513 – 516.
23. Jones, Ronald W. (2006), "'Protection and Real Wages': The History of an Idea", *Japanese Economic Review* 57, pp. 457 – 466.
24. Kapsos, S. and Bourmpoula, E. (2013), 'Employment and Economic class in the Developing world', *ILO Research Paper* 6.
25. Kar, S., Marjit, S. and Sarkar, P. (2003), 'Trade reform, internal capital mobility and informal wage: Theory and evidence', *WIDER Conference on Sharing Global Prosperity*, Helsinki.
26. Kar, S. and Marjit, Sugata (2009), 'Urban Informal Sector and Poverty', *International Review of Economics and Finance* 18, pp. 631–642.
27. Kathuria, Vinish, Rajesh S.N. Raj and Kunal Sen (2012), 'Productivity Measurement in Indian Manufacturing: A Comparison of Alternative Methods' *Journal of Quantitative Economics* 11 (No.s 1 & 2).
28. Kathuria, Vinish, Rajesh S.N. Raj and Kunal Sen (2013), 'The effects of economic reforms on manufacturing dualism: Evidence from India' *Journal of Comparative Economics* 41, pp. 1240–1262.
29. Koizumi, T. and Kopecky, K. J. (1977), 'Economic Growth, Capital Movements and the International Transfer of Technical Knowledge', *Journal of International Economics* 7, pp. 45–65.
30. Koizumi, T. and Kopecky, K. J. (1980), 'Foreign direct investment, technology transfer and domestic employment effects', *Journal of International Economics* 10, pp. 1–20.
31. Krugman, Paul R. (2000), 'Technology, trade and factor prices', *Journal of International Economics* 50, pp. 51 – 71.
32. Marjit, S. (2003), 'Economic Reform and Informal Wage: A General Equilibrium Analysis', *Journal of Development Economics* 72(1), pp. 371-378.
33. Marjit, S., Ghosh, S. and Biswas, A.K. (2007), 'Informality, Corruption and Trade Reform', *European Journal of Political Economy* 23(3), pp. 777 – 789.
34. Marjit, S. and S. Kar (2004), 'Pro-Market Reform and Informal Wage: Theory and the Contemporary Indian Perspective', *India Macroeconomics Annual 2004-05*, pp. 130-156.
35. Marjit, S, S Kar and H Beladi (2007), 'Trade Reform and Informal Wages', *Review of Development Economics* 11(2), pp. 313-320.
36. Marjit, S., Kar, S. and R Acharyaa (2007): 'Agricultural Prospects and Informal Wage in General Equilibrium', *Economic Modelling*, 24(3), pp. 380-385.

37. Marjit, S., and Kar, S. (2008), ‘Labor Productivity Growth, Informal Wage and Capital Mobility – A General Equilibrium Analysis’, in Ravi Kanbur and Jan Svejnar (Eds.) *Labour Markets and Economic Development*, NY: Routledge, 2008.
38. Marjit, S., and Kar, S. (2008), ‘Productivity and Wage in the Informal Sector’ in *Footprints of Development and Change:Ch 5 (V K R V Rao Centenary Volume)*, New Delhi: AF.
39. Marjit, S., Kar, S. and D. Maity (2008), ‘Labour Market Reform and Poverty – The Role of Informal Sector’ in Bhaskar Dutta (ed.), *Issues in Development* (NY: World Scientific Press).
40. Marjit, S., and Kar, S. (2009), ‘A Contemporary Perspective on the Informal Labour Market: Theory, Policy and the Indian Experience’, *Economic and Political Weekly* Vol. XLIV, No. 14, pp. 60 – 71.
41. Mukherjee, Soumyatanu (2012), ‘Revisiting the Apparent Paradox: Foreign Capital Inflow, Welfare Amelioration and ‘Jobless Growth’ with Agricultural Dualism and Non-traded Intermediate Input’; *Journal of Economic Integration*, 27(1), pp. 123-133.
42. Mukherjee, Soumyatanu (2014), ‘Liberalisation and ‘Jobless Growth’ in Developing Economy – Some Extended Results’; *Journal of Economic Integration*, Vol. 29, No. 3 (forthcoming).
43. Pathy, J (1993), ‘The Dreary December and the Oriya Textile Workers in Surat’, *Mimeo*, South Gujarat University, Surat.
44. Jhavbala, R. and Subrahmanya, R. K. A (2000), *The Unorganised Sector: Work Security and Social Protection*. Sage Publications. New Delhi.
45. Ramaswami, K.V. (1999), ‘The Search for Flexibility in Indian Manufacturing: New Evidence on Outsourcing Activities’, *Economic and Political Weekly*, Vol. 34(6), pp. 363-368.
46. Schneider, F. and Enste, D.H. (2000), ‘Shadow Economies: Size, Causes, and Consequences’, *Journal of Economic Literature* 38, pp. 77 – 114.

Appendix I

i. Proof of Proposition 1:

Totally differentiating Equations (1), (2.1), (3) and (4); applying ‘envelope conditions’¹⁴ and using Cramer’s rule one can obtain:

$$\begin{pmatrix} \theta_{L1} & 0 & -1 & 0 \\ \theta_{L2} & \theta_{K2} & 0 & -1 \\ 0 & \theta_{K3} & 0 & \theta_{23} \\ 0 & \theta_{K4} & 0 & 0 \end{pmatrix} \begin{pmatrix} \widehat{W} \\ \widehat{r} \\ \widehat{P}_1 \\ \widehat{P}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -\widehat{\rho}\theta_{K2} \\ 0 \\ \alpha \end{pmatrix} \quad (\text{A.1})$$

¹⁴ This stems from the fact the competitive producers in each sector choose techniques of production in order to minimise unit costs of production. See Caves et al. (2002) for details.

That is if sector 4 undergoes technological progress of $\alpha > 0$, ceteris paribus, and if government also undertakes a policy of capital market reform in the informal sector ($\hat{\rho} < 0$), we get

$$\widehat{W} = \left\{ \underbrace{-\alpha(\theta_{K3} + \theta_{23}\theta_{K2})/(\theta_{23}\theta_{L2}\theta_{K4})}_{<0} \right\} + \left(\underbrace{-\hat{\rho}\theta_{K2}/\theta_{L2}}_{>0} \right) \quad (\text{A.2})$$

So informal wage falls unambiguously; however in absence of any government policy of credit market reform (the latter is captured by second term in the RHS, which would have a positive impact on informal wage).

$$\hat{r} = (\alpha/\theta_{K4}) > 0 \quad (\text{A.3})$$

$$\hat{P}_2 = -\alpha\theta_{K3}/(\theta_{23}\theta_{K4}) < 0 \quad (\text{A.4})$$

Totally differentiating Equations (8) and (10) (not taking into account any reform policy in informal credit market) and assuming production functions in sectors 2, 3 and 4 are of Cobb-Douglas type and solving simultaneously by Cramer's rule for \widehat{X}_i yields¹⁵

$$\widehat{X}_3 = \hat{r} \{ \Theta - \lambda_{S4}r(\rho - 1)\hat{r} K'_1(\cdot)/\bar{K} \} / (\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) \quad (\text{A.8})$$

Or,

$$\widehat{X}_3 = (\alpha/\theta_{K4}) \{ \Theta - \lambda_{S4}r(\rho - 1)\hat{r} K'_1(\cdot)/\bar{K} \} / (\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) \quad (\text{A.9})$$

Since sector 4 is relatively capital-intensive vis-à-vis the vertically integrated export sector in physical and value-sense, $(\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) < 0$. Also

$$\Theta = (\lambda_{S4}\lambda_{K3}\theta_{S3} + \lambda_{K4}\lambda_{S4}(1 + \theta_{S4}) + \lambda_{S3}\lambda_{K4}\theta_{K3}) > 0 \quad (\text{A.9.1})$$

The RHS of Equation (A.9) is negative under the sufficient condition $\Theta > \lambda_{S4} \frac{K'_1(\cdot)}{\bar{K}} r(\rho - 1)$ [i.e., the 'first-round effect' dominates the 'second-round effect']. So without any government policy of credit market reform in the informal sector, from Equation (A.9), it is evident that \widehat{X}_3 is likely to be negative. Similarly one can show that it is likely $\widehat{X}_4 > 0$ without any government policy of credit market reform in the informal sector.

It is also straightforward from Equation (11) that $\widehat{X}_3 = \widehat{X}_2$ since $\lambda_{23} = \frac{a_{23}X_3}{X_2} = 1$. So sector 2 will also contract. Now totally differentiating Equation (9) and substituting $\widehat{X}_2 = \widehat{X}_3$ from Equation (A.9) and using Equations (A.2) and (A.3); one can show that without any government policy of credit market reform in the informal sector, $\widehat{X}_1 > 0$ iff

¹⁵ Detail derivations of these expressions will be available from the authors upon request.

$\Theta > \left[\lambda_{S4} \frac{K'_1(\cdot)}{\bar{K}} r(\rho - 1) + \{(\widehat{\theta}_{K3}/\theta_{23}\theta_{L2}) + 1\}(\lambda_{S3}\lambda_{K4} - \lambda_{K3}\lambda_{S4}) \right]$ holds (where $\widehat{\theta}_{K3} = \theta_{K3} + \theta_{23}\theta_{K2}$). Hence we have our proposition 1.

ii. Proof of Proposition 2:

If sector 3 undergoes technological progress of $\alpha > 0$, ceteris paribus, and if government also undertakes a policy of capital market reform in the informal sector ($\widehat{\rho} < 0$),

$$\begin{pmatrix} \theta_{L1} & 0 & -1 & 0 \\ \theta_{L2} & \theta_{K2} & 0 & -1 \\ 0 & \theta_{K3} & 0 & \theta_{23} \\ 0 & \theta_{K4} & 0 & 0 \end{pmatrix} \begin{pmatrix} \widehat{W} \\ \widehat{r} \\ \widehat{P}_1 \\ \widehat{P}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -\widehat{\rho}\theta_{K2} \\ \alpha \\ 0 \end{pmatrix} \quad (\text{A.10})$$

Solving Equation (A.10) by Cramer's rule we get

$$\widehat{W} = \left\{ \underbrace{\alpha\theta_{K4}/(\theta_{23}\theta_{L2})}_{>0} \right\} + \left(\underbrace{-\widehat{\rho}\theta_{K2}/\theta_{L2}}_{>0} \right) \quad (\text{A.11.1})$$

Thus, informal wage will unambiguously increase even in the absence of any government policy of credit market reform ($\widehat{\rho} < 0$). Moreover, following a government policy of credit market reform informal wage will also increase. However we shall not consider any government intervention in the informal credit market in our comparative static exercises. So ρ is parametrically given and we have

$$\widehat{W} = \alpha\theta_{K4}/(\theta_{23}\theta_{L2}) > 0 \quad (\text{A.11.2})$$

However now,

$$\widehat{r} = 0; \widehat{P}_2 = (\alpha/\theta_{23}) > 0 \quad (\text{A.12})$$

Since r and hence R are not changing given ρ , there is no change in credit allocation among the two domestic credit markets. So we can express the full utilisation condition for capital as

$$a_{K2}X_2 + a_{K3}X_3 + a_{K4}X_4 = \bar{K} \quad (\text{A.13})$$

Totally differentiating Equation (A.13) and utilising $\widehat{X}_3 = \widehat{X}_2$ (given the complementary relationship between sectors 2 and 3, since $\lambda_{23} = \frac{a_{23}X_3}{X_2} = 1$) we have¹⁶

$$\widehat{X}_3 = -\lambda_{K2}\theta_{L2}\lambda_{S4}\widehat{W}/|\lambda| \quad (\text{A.16})$$

Or substituting for \widehat{W} from Equation (A.11.1),

¹⁶ Note that for a given ρ , since r is not changing, we have $\widehat{a}_{K3} = \widehat{a}_{K4} = \widehat{a}_{S3} = \widehat{a}_{S4} = 0$.

$$\widehat{X}_3 = -\alpha\theta_{K4}\lambda_{K2}\lambda_{S4}/(\theta_{23}|\lambda|) \quad (\text{A.17})$$

And

$$\widehat{X}_4 = \alpha\theta_{K4}\lambda_{K2}\lambda_{S3}/(\theta_{23}|\lambda|) \quad (\text{A.18})$$

Where $|\lambda| = (\widetilde{\lambda}_{K3}\lambda_{S4} - \lambda_{K4}\lambda_{S3}) < 0$ if and only if the vertically integrated export sector is relatively less capital-intensive compared to the import-competing sector. Then we have from Equations (A.17) and (A.18) that $\widehat{X}_3 > 0$ and $\widehat{X}_4 < 0$. This is precisely what has been argued in proposition 2.

Table A1.1: Parameter Values

θ_{S3} = Cost-share of skilled-labour in the export sector = [0.5, 0.6] (Marjit et al. 2011).

θ_{23} = Cost-share of intermediate input in the export sector. To find an estimate of this parameter, we construct a measure of formal sector subcontracting using the ASI data, which is the sum of: purchase value of goods sold by the registered factories in the same condition as purchased from others; and cost of contract and commission work done by others on materials supplied by the registered factory. θ_{23} = Ratio of value-added by the subcontracting activity defined above to the value-added in organised sectors. This ratio remained almost the same over 1999 – 1996 at around 0.08, increased to 0.15 from 1996 to 1999, but again remained stagnant over 1999 – 2005 at around 0.14 and then it declines. Given the complementarity assumption between sector 2 and sector 3 (i.e. per-unit requirement of the intermediate input produced by sector 2 is fixed in sector 3); we can take it as constant $\cong 0.1$.

θ_{K3} = Cost-share of capital in the export sector = $1 - \theta_{S3} - \theta_{23} = [0.3, 0.4]$.

θ_{S4} = Cost-share of skilled labour (managerial and supervisory employees) in the import-competing sector $\cong [0.4, 0.5]$ (Abraham 2010; Berman et al. 2005; Marjit and Kar 2008).

$\theta_{K4} = 1 - \theta_{S4} = [0.5, 0.6]$.

This is also consistent with our theoretical assumption that sector 4 is relatively capital-intensive vis-à-vis the vertically integrated sector 3 in value-sense, since we have $\theta_{K4}\theta_{S3} > \widetilde{\theta}_{K3}\theta_{S4}$. This trivially implies sector 4 is relatively capital-intensive in physical terms as well.

θ_{K2} = Cost-share of capital in the intermediate-input producing sector $\cong [0.3, 0.5]$ (Marjit et al. 2011).

θ_{L2} = Cost-share of labour in the intermediate-input producing sector = $1 - \theta_{K2} =$

Appendix II

Derivation of TFPG in the organised sectors on State-specific level:

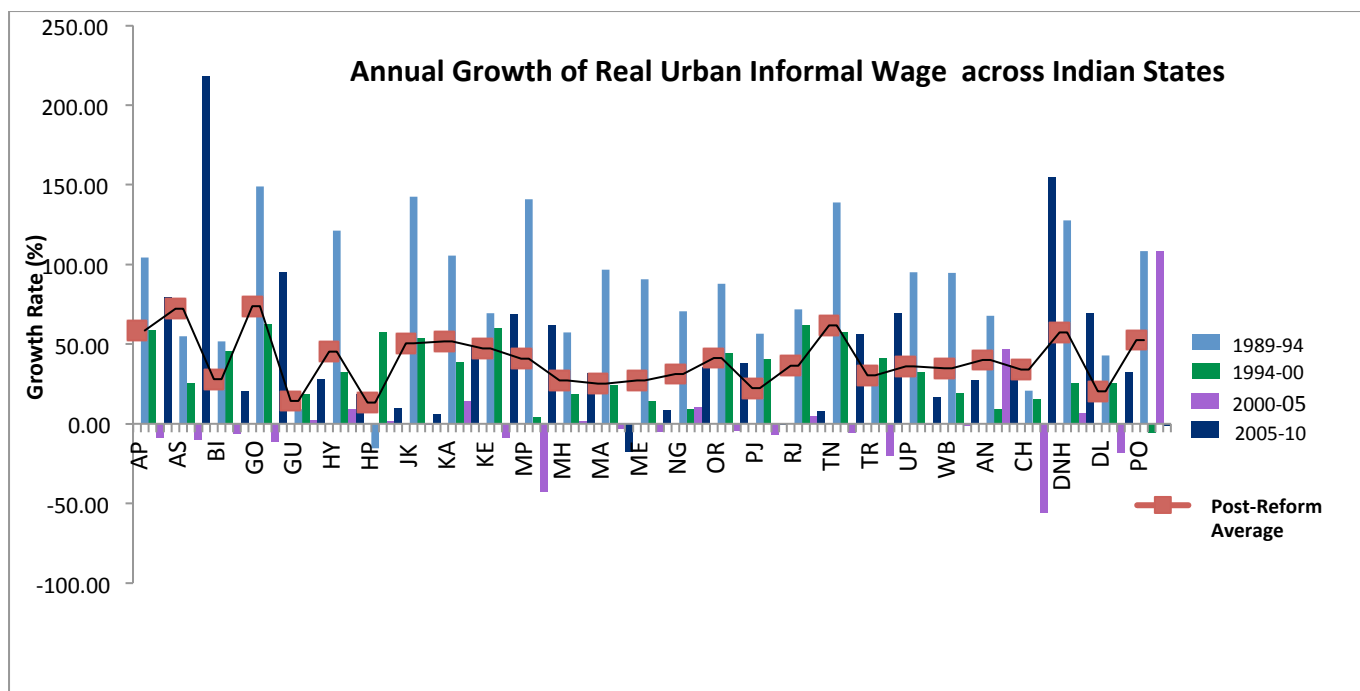
First we have derived net value added (net VA) = gross value added – value addition by intermediate inputs – depreciation. Then we deflate this variable using WPI for 2001-02 base year. The TFPG = growth rate of net VA – weighted growth rates of capital and labour (when the weights are share of the factors in net value-added). So Divisia-Tornquist (D-T) approximation has been used for the calculation of TFPG. The TFPG under the D-T approximation is given by the following equation:

$$TFPG = (\ln Q_t - \ln Q_{t-1}) - \frac{1}{2} [(s_{L,t} - s_{L,t-1})(\ln L_t - \ln L_{t-1}) + (s_{K,t} - s_{K,t-1})(\ln K_t - \ln K_{t-1})] \quad (A.19)$$

Where Q = net VA, s_L = share of labour in net VA; s_K = share of capital in net VA. We consider the share of emoluments in net value added as s_L . Assuming CRS, $s_K = 1 - s_L$.

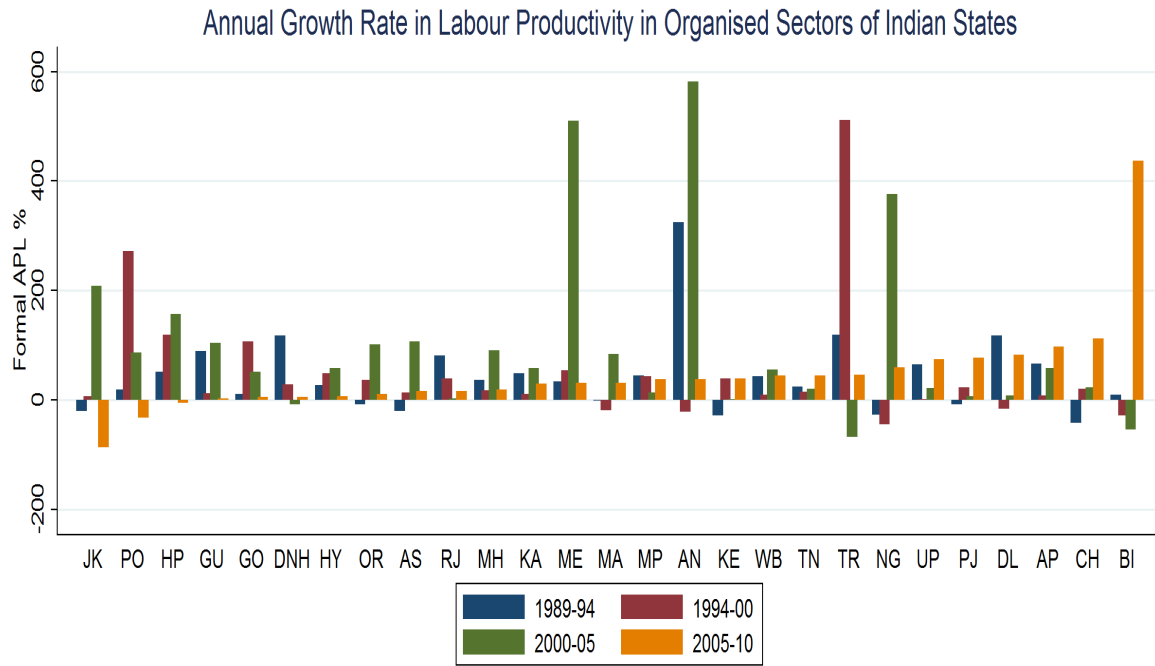
Appendix III:

Figure A3.1



Source: NSS surveys, various rounds. **NOTES:** AN – Andaman & Nikobar; AP – Andhra Pradesh; AS – Assam; BI – Bihar; CH – Chandigarh; DL – Delhi; DNH – Dadra-Nagar-Haveli; GO – Goa; GU – Gujrat; HP – Himachal Pradesh; HY – Haryana; JK – Jammu & Kashmir; KA – Karnataka; KE – Kerala; MA – Manipur; ME – Meghalaya; MH – Maharashtra; MP – Madhya Pradesh; NG – Nagaland; OR – Orissa; PJ – Punjab; PO – Pondicherry; RJ – Rajasthan; TN – Tamil Nadu; TR – Tripura; UP – Uttar Pradesh; WB – West Bengal.

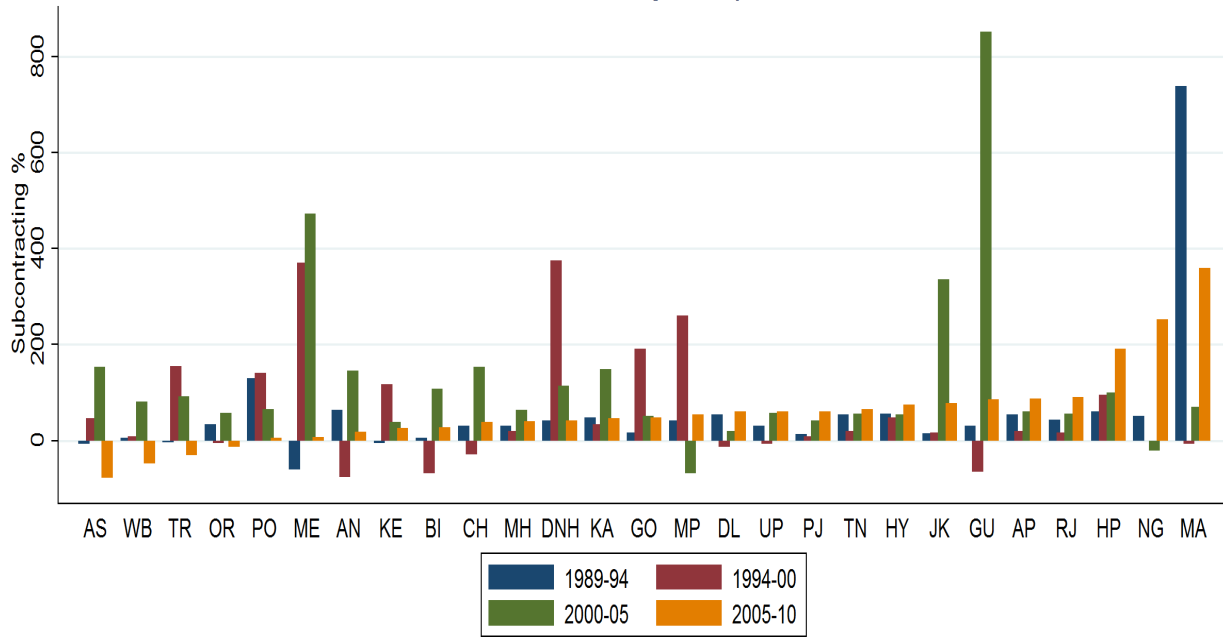
Figure A3.2



Source: ASI surveys, various rounds.

Figure A3.3

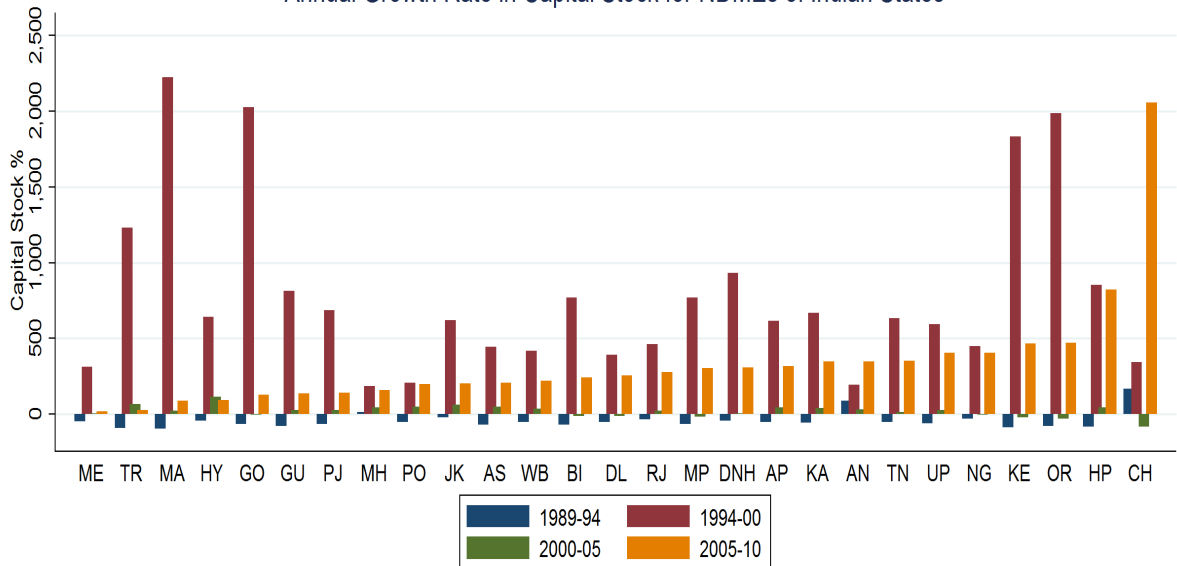
Annual Growth Rate in Subcontracting Activity in NDMEs of Indian States



Source: ASI and NSS surveys, various rounds and own calculations.

Figure A3.4

Annual Growth Rate in Capital Stock for NDMEs of Indian States



Source: NSS surveys, various rounds.

Figure A3.5: Intermediate Input Usage by Formal Sectors versus Formal Labour Productivity for 1994

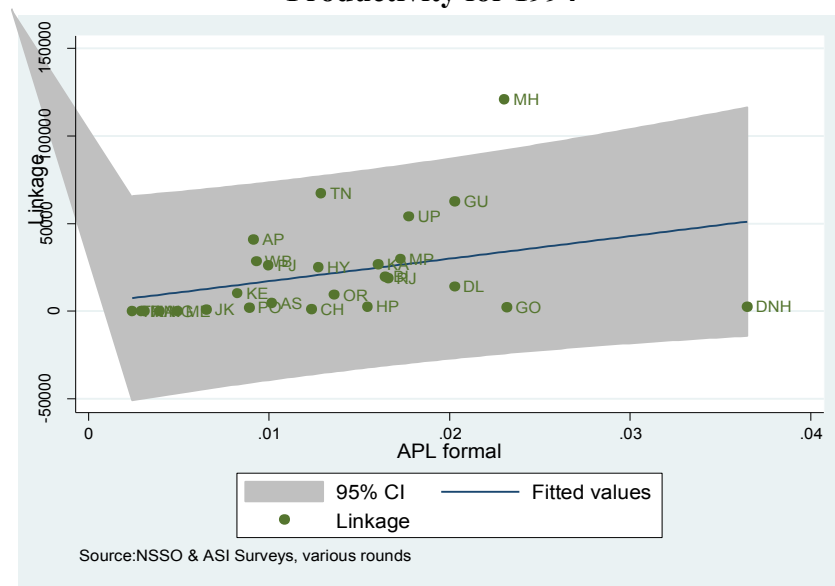


Figure A3.6: Intermediate Input Usage by Formal Sectors versus Formal Labour Productivity for 2010

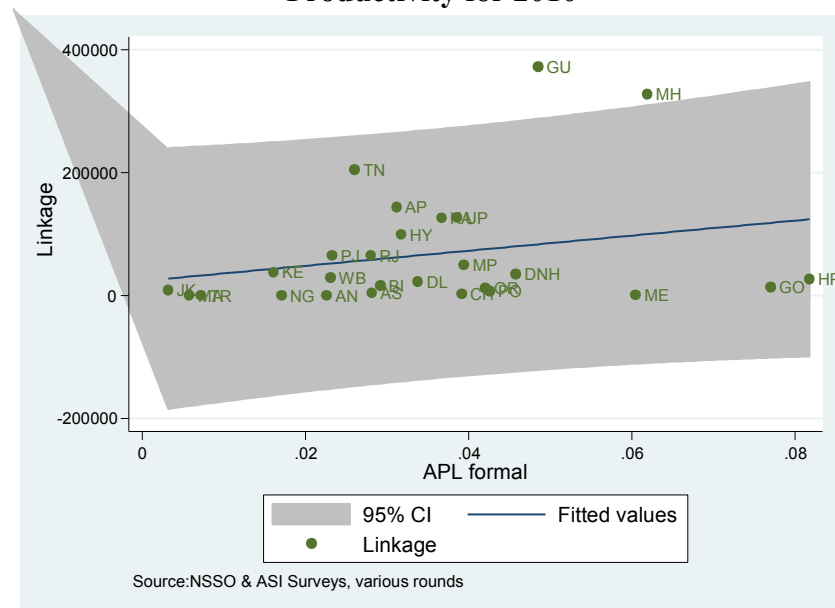


Table A3.1: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Informal Wage 1989	27	90.10185	37.58973	47.32	180.01
Fixed Assets 1989	27	775.9122	441.5575	298.34	1937.68
Linkage 1989	27	15927.22	21047	1.93	92680.77
Informal Wage 1994	27	151.2089	35.65809	96.69	211.79
Fixed Assets 1994	27	441.3022	559.9268	46.83	2874.97
Linkage 1994	27	21081.6	28079.55	16.17	120840.9
Informal Wage 2000	27	197.2741	37.49708	117.8	264.97
Fixed Assets 2000	27	2617.223	2267.978	810.1	12748.86
Linkage 2000	27	25532.24	35163.41	14.84	144254.9
Informal Wage 2005	27	194.5222	52.57534	94.78	321.53
Fixed Assets 2005	27	2827.415	1623.554	1079.22	7698.67
Linkage 2005	27	43442.49	60077.58	25.11	236271.8
Informal Wage 2010	27	269.1952	75.94624	153.08	438.77
Fixed Assets 2010	27	12006.97	12035	1593.86	56504.33
Linkage 2010	27	66629.96	97603.66	79.41	372947.4

Table A3.2: Regression Results

	Pooled OLS Model	Random Effects Model	Fixed Effects Model
Dependent Variable: Real Urban Informal Wage			
Fixed Assets	0.0047 (0.00175)***	0.0047 (0.00178)***	0.0044 (0.00177)***
Linkage	0.0003 (0.00007)***	0.0003 (0.00008)***	0.0005 (0.00022)***
N	135	135	135

Note: Standard Errors in Parentheses. Significance level: 1%***, 5%** , 10%*.

Figure A3.7

Source: Planning Commissions and NSSO data, various rounds and authors' calculations.

Appendix References:

1. Abraham, V. (2010), "The effect of information technology on wage inequality: evidence from Indian manufacturing sector"; *CDS working papers*, no.437, Trivandrum, CDS.
2. Berman, E., Somanathan, R. and Tan, H.W. (2005), "Is Skill-biased Technological Change Here Yet? Evidence from Indian Manufacturing in the 1990s"; *World Bank Policy Research Working Paper* 3761.
3. Caves, R.E., Frankel, J.A. and Jones, R.W. (2002), *World Trade and Payments: An Introduction*, Ninth Edition; Pearson/Addison Wesley, S-17 – S-28.
4. Marjit, S., Kar, S. and Chaudhuri, S. (2011), "Recession in the skilled sector and implications for informal wage", *Research in Economics* 65, pp. 158–163.
5. Marjit, S., and Kar, S. (2008), "Labor Productivity Growth, Informal Wage and Capital Mobility – A General Equilibrium Analysis", in Ravi Kanbur and Jan Svejnar (Eds.) *Labour Markets and Economic Development*, NY: Routledge, 2008.
6. Annual Survey of Industries, Ministry of Statistics and Programme Implementation, Government of India (various issues).
7. National Sample Survey Organization of India (NSSO). (1989–2010). Survey of Unorganized Manufacturing Sector in India, Department of Statistics and Programme Implementation, Government of India — various issues.
8. Planning Commission, Government of India (2007-2014). 'Report of the Expert Group to Review the Methodology for Measurement of Poverty'.